



**EXAMINING BENEFITS OF DEDICATED  
FUNDING AND PROCESS IMPROVEMENT  
FOR DEPOT LEVEL TECHNOLOGY  
INSERTION  
GRADUATE RESEARCH PAPER**

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EXAMINING BENEFITS OF DEDICATED FUNDING AND PROCESS  
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### **Abstract**

The Air Force's aging fleet challenges are compounded by initiatives to maintain aircraft longer than originally programmed. These challenges warrant a strategic effort to fund and implement demonstrated technology for weapon systems and depots. In an effort to facilitate this process, Air Force Material Command created a new organization called the Sustainment Technology Process office, and formally defined the organizational structure to include designation of a Senior Sustainment Steering Committee, Senior Review Group, and Technology Working Groups. This office is located at Headquarters Air Force Material Command at Wright Patterson Air Force Base, Ohio. The Sustainment Technology Process (STP) office is tasked with providing a systematic and repeatable method for identifying sustainment needs from identification to final implementation. It is intended to create a strategic partnership with the science and technology providers and the sustainment, test, and acquisition communities to address sustainment technology opportunities. In turn, these opportunities provide a roadmap for solution planning and programming in direct support of weapon systems and the warfighter. As indicated by a request for research in the area, senior sustainment personnel believe there is room for improvement in STP processes. This research effort is an attempt to provide process improvement methodology and dedicated funding recommendations for the sustainment technology process in order to provide maximum benefit for our depots and weapons systems.

## Table of Contents

Abstract .....	iv
List of Figures .....	vii
List of Tables .....	viii
I. Introduction .....	1
Background.....	1
Stakeholders and the Technology Insertion Process .....	2
Technology Insertion .....	3
Problem Motivation.....	4
Problem Statement.....	6
Research Objective .....	6
Methodology.....	6
Assumptions .....	7
Limitations .....	7
Implications .....	8
II. Literature Review .....	9
Chapter Overview .....	9
Problem and Context .....	9
Process Improvement .....	10
Air Force Smart Operations for the 21 <sup>st</sup> Century .....	11
Theory of Constraints .....	13
Lean .....	14
Six Sigma.....	14
Business Process Reengineering .....	15
Interorganizational Relationships .....	17
Funding Issues .....	19
Synthesis .....	20
III. Methodology .....	21
Chapter Overview .....	21

Determination of Methodology .....	21
The Process of Data Gathering.....	24
Data Collection Methods .....	25
Data Analysis Methods.....	27
Summary.....	28
IV. Results and Analysis.....	29
Introduction .....	29
Demographics .....	29
Case A.....	30
Case B.....	31
Case C.....	33
Case D.....	34
Case E .....	35
Case Study Data Summary .....	37
Summary.....	42
V. Conclusions and Recommendations .....	44
Conclusions .....	44
Strategy .....	44
Communication .....	45
Education & Training .....	46
Process Improvement .....	47
Funding.....	48
Summary of Recommendations.....	50
Recommendations for Future Research.....	51
Summary.....	51
Bibliography .....	53
Vita.....	55
Appendix A.....	56
Blue Dart.....	56
Quad Chart.....	58

## List of Figures

Figure 1. ALC Technology Insertion Figure Process .....	2
Figure 2. Sustainment Technology Process .....	3
Figure 3. Air Force AFSO21 Problem Solving Method .....	12
Figure 4. Category Summary Results .....	<b>Error! Bookmark not defined.</b>
Figure 5. Process improvement phased based approach.....	49



## **List of Tables**

Table 1. BPR Methodology .....	16
Table 2. Process Improvement Summary .....	18
Table 3. Demographic Data .....	30
Table 4. Categorized Case Study Results .....	38
Table 5. Case Study Summary .....	41

# EXAMINING BENEFITS OF PROCESS IMPROVEMENT AND DEDICATED FUNDING FOR DEPOT LEVEL TECHNOLOGY INSERTION

## **I. Introduction**

### **Background**

The Air Force's aging fleet challenges are compounded by initiatives to sustain aircraft longer than originally programmed. These challenges warrant a strategic effort to facilitate and implement demonstrated technology for weapons systems at sustainment depots. The importance of this issue was solidified in 2006 when the Government Accountability Office (GAO) was tasked to complete an in-depth analysis on technology transition processes (GAO, 2006). The results of this and other studies on technology transition and insertion efforts prompted Air Force Material Command (AFMC) to revolutionize and redefine the process for facilitating technology insertion to support depot requirements. To assist the new process, AFMC created a new organization called the Sustainment Technology Process (STP) office, and formally defined the organizational structure to include designation of a Senior Sustainment Steering Committee (S3C) and its members, Sustainment Review Group (SRG) and its members, and finally, four Technology Working Groups (TWG's) with separate focus areas. This new office is located at Headquarters Air Force Material Command (AFMC) at Wright- Patterson Air Force Base, Ohio. The office is tasked with facilitating the rapid migration of proven technologies to the Air Logistics Centers (ALCs) in direct support of the warfighter, but currently has no dedicated funding to accomplish its mission.

## Stakeholders and the Technology Insertion Process

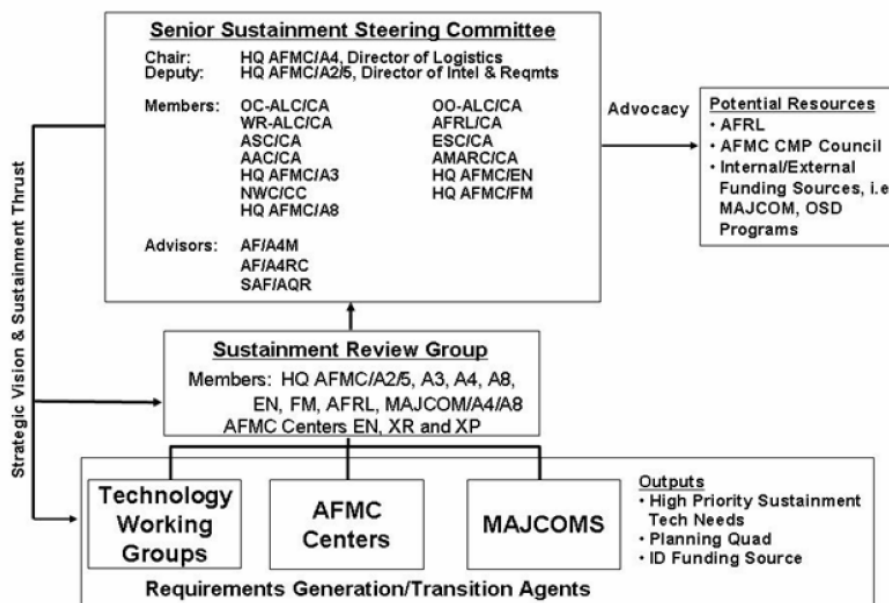
The current technology insertion process encompasses three phases: research, transition, and implementation as depicted in Figure 1:

<u><i>Phase</i></u>	<b>Research</b>	<b>Transition</b>	<b>Implementation</b>
<u><i>Activity</i></u>	<b>Research Technology</b>	<b>Develop Technology</b>	<b>Deploy Technology</b>

**Figure 1. ALC Technology Insertion Process**

The STP program office is intended to have a broad view of all three areas, but specifically focus on facilitating the rapid migration of proven technologies to the depot for implementation. The governing bodies tasked with making this process successful are the S3C, the SRG and the TWGs. The S3C is responsible for providing direction and oversight of sustainment technology through development, transition and implementation (AFMCGM 61-101, 2007). The SRG is tasked with prioritizing needs, identifying cross-cutting needs applicable to all depots, and recommending inputs to the S3C (AFMCGM 61-101, 2007). Finally, overall requirements for new technology are derived from the requirements generators, mainly the TWGs which were established as cross functional teams to help identify and address technology requirements issues. Additional requirement generators for new technology are the sustainment centers, product centers, and the Major Commands (MAJCOMs) (AFMCGM 61-101, 2007). Although the STP office is directly involved in collaborating with all of the stakeholders, their main thrust is to help facilitate the migration of proven technologies to the depots in line with the strategic

drivers identified by the senior level stakeholders. Thus, the STP office is not directly involved in the research and transition phases, but focuses on implementation as an advocate for funding to get proven or mature technologies fully implemented. The key stakeholders and basic outline of the process are displayed in Figure 2:



**Figure 2. Sustainment Technology Process (AFMCGM 61-101, 2007)**

## Technology Insertion

Before proceeding, it is important to understand what technology insertion is and why it is vital to sustainment of depot related functions. In a broad sense, technology insertion is a cyclical process involving the research and development, transition, and implementation of new technologies in a manner useful to accomplishing your overall objective. With respect to the focus of this research, technology insertion will focus on the implementation of proven

technologies to the depot in order to achieve Air Force sustainment objectives. It is in this realm that the STP office must help to facilitate support for continued improvement of depot technology and equipment to help ensure sustainment objectives remain on track. In that regard and for the purpose of this research, technology insertion includes mature organically developed technology and procuring commercial off-the-shelf (COTS) solutions to depot related sustainment problems, and the STP office is the main facilitator to ensure that the most cost effective and cross-cutting solutions are implemented in line with strategy set by the senior sustainment steering committee.

### **Problem Motivation**

AFMC has attempted to provide a systematic and repeatable approach for identifying sustainment requirements across the lifecycle of all programs. Currently the process involves almost every facet of the sustainment technology chain, including partnerships with industry. The basic construct is that the sustainment technology process begins with industry or Air Force Research Laboratory (AFRL) research and development, fielding and testing, procurement, product maturation, and finally implementation at the depot or product center. Organic sustainment technology advancement is a very complex process. It takes a considerable amount of time, forethought, funding, and effort to stay on the leading edge and ensure depots continue to perform world-class operations in support of weapon systems. The process as it exists today is intended to create a strategic partnership between the science and technology provider and the acquisition, test, and sustainment communities in order to address sustainment technology opportunities throughout the lifecycle of applicable weapons systems. Over the past decade the problem of sustaining technology commensurate with the advancement of today's new weapons

systems has proven to be at best challenging. Budget cuts and aversion to investment risk provide seemingly insurmountable roadblocks to sustained improvement, especially at the depot level. Couple this fact with aging fleet concerns across the spectrum of Air Force operations, and it is easy to see how crucial it is to explore dedicated funding sources for technology insertion. Of equal importance is the requirement to identify and implement standardized sustainment technology processes to ensure synergy with Air Force strategic goals and objectives. From the initial implementation of STP, there have been numerous attempts to enhance the effectiveness of the system. This has prompted multiple agencies to examine the system and provide recommendations and potential solutions for effective and efficient technology insertion for Air Logistics Centers. The main factors effecting successful technology insertion are the same factors that impact most organizations and will be examined in more detail later in this report. This research was motivated by a request from Depot Maintenance Operations Division of the Directorate of Logistics and Sustainment, Air Force Materiel Command (AFMC/A4D). The main focus of this research is to shed light on process improvement tools and techniques to facilitate improvements to the technology insertion process including the STP office and their counterparts. Application of these tools and techniques should take into consideration Air Force sustainment goals and objectives. Secondly, the research will provide funding recommendations and potential sources of funding to ensure technology insertion initiatives can be achieved to help support sustainment goals. Motivation for this research initiative, requested by AFMC/A4D, stems from the fact that after recent attention from Air Force inspection and government audit teams, problems facing the sustainment technology processes and potential for continuous process improvement still persist.

## **Problem Statement**

The Air Force's aging fleet challenges are compounded by initiatives to maintain and sustain aircraft longer than originally programmed. These challenges warrant a strategic effort to fund and implement a process dedicated to the cause of inserting demonstrated and proven technology for weapons systems and sustainment depots. The current method for accomplishing this objective requires analysis to determine a means to improve its effectiveness.

## **Research Objective**

The focus of this research is to identify a relevant methodology for applying process improvement initiatives that will have the greatest impact on the STP program and related processes, and to provide recommendations for funding sources and funding levels to achieve desired effects. General categories, and specific recommendations, aimed at improving the overall effectiveness and efficiency of the program will serve as the primary focus.

## **Methodology**

The methodology employed in this research was strictly qualitative in nature. The specific method being used was exploratory case study analysis. Data were collected using various qualitative research techniques, including program orientation visits, face-to-face and telephonic discussions, and researcher observation and interaction with depot and sustainment personnel. To capture as many perspectives as possible, research efforts targeted personnel representing the full gamut of STP processes, including military, government civilian, and contractor personnel at various ranks and organizational levels.

## **Assumptions**

Two key assumptions were made regarding this research: 1) The projects examined by case study are representative of sustainment technology insertion efforts across the spectrum of depot operations and 2) The data gathered during the timeframe of this research project is not time dependent. That is to say that this data is representative of data that would be collected in a future study of similar scope and intent.

## **Limitations**

All research conducted was qualitative in nature and involved personal interaction in either a face-to-face, telephonic, or electronic mail interaction. The researcher attempted to limit respondent bias by explaining that the main endeavor was to understand the system as it existed in its current state and that the researcher's efforts would merely be recommendations and may not have any effect on the outcome of the research implications. Additionally, the researcher ensured all subjects and respondents that there would be confidentiality and non-retribution for any and all inputs received during interactions. The effects of respondent and organizational biases were minimized by ensuring interaction with multiple organizations and key stakeholders who were viewed as subject matter experts to characterize the overall population of STP projects as a representative sample. Although every attempt was made to discourage any subject bias, these biases cannot be completely eliminated and could have an impact on the final recommendations of this report. Additionally, although there have been over 60 technology insertions involving some interaction with the STP program office, the limited timeframe of this research project prohibited a complete examination of all of the programs.



## **Implications**

The intent of this research is to provide insight for the AFMC STP program office and associated stakeholders as to current areas requiring improvements. It will also provide methodology based recommendations for improving current processes to identify a path for achieving long-term dedicated funding and funding sources. Feasible and actionable findings may allow the STP office to leverage appropriate funding and implement process improvement techniques to ensure a viable technology insertion process and continued their support of the Air Force's aging fleet in order to promote a more capable and effective sustainment system for the warfighter.

## **II. Literature Review**

### **Chapter Overview**

Sustainment Technology Process was coined by the Air Force to identify process ownership of technology insertion to support sustainment goals. Technology insertion is not specific to the Air Force or even the Department of Defense. It is a process used by commercial companies with the basic premise that technologies need to be mature before they are transitioned to the product line (GAO, 2006). For the purpose of this research, sustainment technology process and technology insertion will specifically refer to the ability of AFMC/A4D STP program office help facilitate rapid migration of proven technologies into the depots in line to achieve strategic sustainment goals for the Air Force. In that light, research began with a review of relevant literature to fully understand STP concepts and processes as they relate to the Air Force, and more specifically, AFMC/A4D. This chapter will discuss the relevant literature to help explain key concepts of process improvement techniques and provide an overview of sustainment technology processes, and structure. Additionally, it will provide an overview of the current funding structure for the STP process. This chapter will also discuss various process improvement programs and techniques directly related to addressing the research problem.

### **Problem and Context**

Literature specific to Sustainment Technology Process as a system is relatively scarce, but literature related to how the Air Force has implemented STP and its effectiveness is much more available. The main sources of literature used to provide a basic understanding of the issue at hand were derived from governmental sources and included pertinent governing regulations

and Air Force instructions. These sources were particularly helpful to this research effort because of the unique perspective the Armed Forces have on the sustainment of weapons systems as opposed to commercial companies. The majority of literature reviewed was from the GAO and Department of Defense reports on technology transition and insertion. These documents were particularly helpful in understanding the evolution of the STP system and why a process needed to be developed to link the science and technology branches of the Department of Defense with a transition source to bring mature technology to sustainment workforce for implementation into depot processes. Literature specific to process improvement and Air Force Smart Operations for the 21<sup>st</sup> Century (AFSO21) provided a basis for additional recommendations on improving the STP process across the spectrum of organizations involved. Finally, GAO reports on funding levels and processes relevant to programs such as STP provided a source to of information on which to base funding recommendations to achieve weapon system sustainment objectives.

## **Process Improvement**

Process improvement has enabled firms to create fast, efficient, cost effective processes in key areas such as product development and logistics. Often these highly refined processes are introduced with little attendant use of advanced technology or radical approaches to human resource management (Davenport, 1993). As identified previously, the Air Force has launched an initiative for continuous process improvement, AFSO21. As Antoline and Green (2008) explain, AFSO21 process improvement is derived from the commercial practices of four proven methodologies, all of which share the traits of continuous process improvement. These methodologies are Lean, Six Sigma, Theory of Constraints (TOC), and Business Process Reengineering (BPR). Key principles contained in these methodologies include improving flow

within a process, focusing on factors that degrade quality in products or services, identifying and overcoming constraints within a process, and potentially the complete redesign of a process (Antoline, 2008). The methodologies specific to this research will focus on continuous process improvement in the realm of Lean, Six Sigma, Theory of Constraints, Business Process Reengineering, and Inter-Organizational relationships. Although this research was purely qualitative in nature, the statistical approaches of Six Sigma could be adapted to combine a mix of qualitative and quantitative data to capture process improvement techniques for STP as a service to the depot technology insertion customers.

### **Air Force Smart Operations for the 21<sup>st</sup> Century**

In order to provide a basis of understanding on process improvement for the Air Force, initial research focused on a tool absolutely relevant to this problem, AFSO21. As former Secretary of the Air Force, Michael Wynne explains, AFSO21 is:

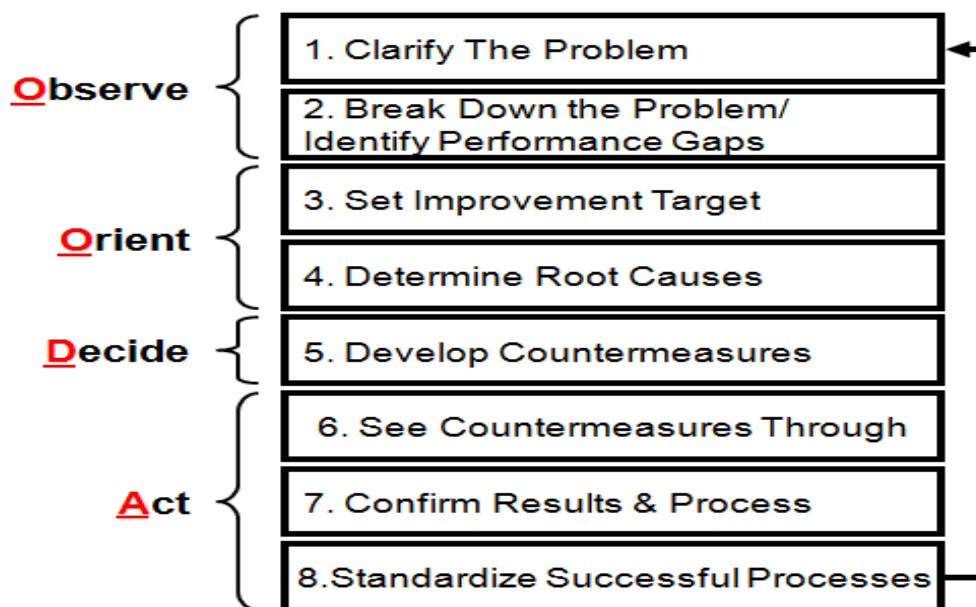
“a dedicated effort to maximize value and minimize waste in our operations.

AFSO 21 is a leadership program for commanders and supervisors at all levels, looking at each process from beginning to end. It doesn't just look at *how* we can do each task better, but asks the tougher and more important question: *Why* are we doing it this way? Is each of the tasks relevant, productive, and value added?

In other words is it necessary at all? With AFSO 21, we will march unnecessary work out the door – forever” (Wynne, 2006)

To justify the appropriateness of AFSO21 for this particular research, Antoline and Green (2008) purport that AFSO21 was introduced as an initiative, in part, as a response to the Air Force's need to modernize and recapitalize an aging aircraft and equipment fleet. Antiquated and stove-

pipelined processes contribute to wide spread inefficiencies throughout all areas of the Air Force, ranging from administration to production processes. The purpose of AFSO21 is to deliver continuous process improvement that is measurable, effective, and sustainable. It includes an eight step process designed to achieve continuous results. The eight steps of the process are depicted in Figure 3:



**Figure 3. AFSO21 Problem Solving Method (Department of the Air Force, 2008)**

The remainder of this chapter will focus on two distinct areas: 1) literature revealing specific techniques for process improvement areas identified by case study analysis of technology insertion projects, and 2) Literature relevant to strategic implications of funding to help ensure the STP process maximizes support of sustainment objectives and thus, support to the warfighter.

## **Theory of Constraints**

Theory of Constraints (TOC) is rooted in the philosophy of continuous process improvement.

As Kim, Mabin, and Davies (2008) explain, it was originally developed by Dr. Elyiahu Goldratt and encompasses a systematic approach to solving organizational problems. The TOC problem solving process encompasses three main streams: strategy tools, performance measurement tools, and thinking process tools. Kim, Mabin, Davies (2008) explain that thinking process tools help problem solvers focus on factors that are currently preventing a system from achieving its goals. Kim, Mabin, Davies (2008) assert, the thinking process tool set is comprised of five logic diagrams or trees. These five are: Current Reality Tree (CRT), Evaporating Cloud (EC), Future Reality Tree (FRT), Prerequisite Tree (PRT), and the Transition Tree (TT). These five logic trees are supported by a set of rules deemed Categories of Legitimate Reservation (CLR). By examining the labels of the logic diagrams, the process summary entails developing a logic tree for each of the following areas: how the current system works, how the system should work, identifying prerequisite needs to achieve the desired change, and finally a logic tree to map the transition process. The overall objective of employing these logic trees or diagrams is to identify problematic symptoms and develop a plan for improvement. The process is intended to flow in sequence, but as Scheinkopf (1999) states, thinking process tools can be used individually to address specific problems. The process should flow in order and in a broad sense the entire effort should answer the following questions, what to change, what to change it to, and finally, how to cause the change.

## **Lean**

Lean thinking is not a new concept. The five specific principles outlined by Womack and Jones (2003) include specifying value, identifying the value stream, creating flow, creating pull, and finally achieving perfection in order to eliminate waste from an organization. Womack and Jones (2003) suggest lean thinking provides a way ahead to do more and more with less and less. In its current state, the STP program office is tasked to support more and more requirements for migrating proven sustainment technology as weapons systems age with less and less resources. That falls directly in line with the need, as Womack and Jones suggest, for application of lean thinking. More specifically the application of identifying customer value, identifying the process map or value stream that creates that value, and moving towards perfection in STP process to ensure the end customer is fully supported. As Antoline and Green (2008) explain, it is important to note that Lean focuses on the identification and elimination of waste within a process and sets the stage for other continuous process improvement approaches, making them more effective.

## **Six Sigma**

Six Sigma is a management strategy which seeks to improve the quality of output by identifying and removing the causes of defects. Although it is most often applied in a manufacturing context to promote quality, it can also be used as a process improvement technique. An article by Antoline and Green (2008) depicts a five step process for applying Six Sigma techniques to guide process improvements. The five step process is outlined below:

- **Define** the purpose and scope of the project. It is also important in this step to capture the voice of the customer, which in short, is capturing the customer's requirements.
- **Measure** the current state of the process and collect reliable data on process speed, quality, and costs that will be used to expose underlying causes of problems.
- **Analyze** the process to identify root causes of problems affecting the product or process and support these discoveries with data.
- **Improve** the process by implementing solutions to root causes and create measurement standards to evaluate results.
- **Control** the process by documenting and standardizing improvements to prevent workers from going back to the old way of doing business. It is also important to develop metrics to be used for regular process auditing.

Although the process was designed to eliminate product defects, Antoline and Green (2008) support its use in the context of process improvement by stating it can be used as part of an AFSO21 initiative by developing a disciplined, data-driven approach to measuring the defects produced by a business process and then systematically determining how to remove them.

### **Business Process Reengineering**

In order to effect productive change, many organizations are implementing Business Process Reengineering (BPR) techniques. As Antoline and Green (2008) suggest, BPR, unlike Kiazen, is not about incremental improvement. It focuses on inventing a totally new business process from a clean slate. BPR does not mean tinkering with what already exists or making incremental changes that leave basic structures intact. It is a complete rethinking of how the process should be performed with a major focus on creating value from a customer's perspective. BPR also focuses on reducing costs and accelerating the flow of information throughout a process. Technology acts as an enabler for BPR by enhancing the flow of information from both within an organization and across organizations. This is particularly relevant to the STP process



with the multitude of organizational interactions and the geographic dispersion of the key stakeholders. Antoline and Green (2008) go on to suggest a six step methodology for BPR which is may be applicable in whole or in part for the STP program. The methodology is outlined in the table below:

**Table 1. BPR Methodology**

<b>Phases</b>
1. Envision New Process
2. Initiating Change
3. Process Diagnosis
4. Process Design
5. Implementation
6. Process Monitoring

As stated previously, this methodology might not be wholly applicable to the STP program office, but provides a tool for implementation of required portions applicable to the process in its current state. Of particular importance is the application of a specific facilitator tool for BPR and AFSSO 21 initiatives. This facilitator tool is explained by Antoline and Green (2008) as a Rapid Improvement Event (RIE). As they purport, if the problem being evaluated is manageable with a small number of people, a small project (just-do-its) may be sufficient to make the improvements needed. Often the problem is larger and several organizations or offices are involved in an RIE. The basic purpose of a RIE is to completely map the service process and then identify the way ahead for improvement with the main object or end state being the ability to identify and implement a plan, that as Antoline and Green (2008) suggest, allows solutions to come to fruition. Gunasekaran and Kobu (2002) explain that organizational restructuring, or

BPR, eliminates barriers for a smooth flow of information. The basic aim of BPR is to deliver quality in a cost effective and timely fashion. Therefore, a business organization should be modified emphasizing coordination of the basic business processes in the chain, from suppliers to customers, as opposed to the existing complex structures of the functional hierarchies. Behavioral changes should precede reengineering. Issues such as training and education, employee empowerment, teamwork, and incentive schemes should be given priority in BPR.

### **Interorganizational Relationships**

The last focus of this chapter will be to explore relevant literature of interorganizational relationships. Because of the plethora of organizational interaction required to migrate proven technologies to the depots, much emphasis should be placed in this area to ensure maximum benefit throughout the process of technology insertion efforts. As the STP program office is the key facilitator of rapid migration of proven technologies, they interact with a multitude of organizations above, below, and across the hierarchical chain. This section will explore the relevant literature related to implementing healthy and productive inter organizational relationships.

After extensively reviewing relevant studies, Barringer and Harrison (2000) conclude that inter-organizational relationships create value by allowing firms to combine resources and share knowledge. This section will focus on identifying characteristics of healthy and productive interorganizational relationships which provide maximum benefits for all parties involved. With the understanding that the successful migration of new technologies to the depot involves a multitude of organizations, it is vital that all the organizations involved work as a cohesive team to meet Air Force level sustainment goals. In that light, there are several attributes of successful

interorganizational relationships that apply to all the program offices and personnel involved in making technology insertion possible. As outlined by Mohr and Spekman (1994), these include trust, commitment, quality communication, and joint planning and problem solving. The combined effects of these attributes better align expectations, goals, and objectives. To summarize the main points of the process improvement methods presented, the methods and techniques have been paired with their expected contributions. Table 2 is a consolidated summary of the aforementioned process improvement guidelines discussed by the literature.

**Table 2. Process Improvement Summary**

<b>Technique / Focus Area</b>	<b>Expected Contributions</b>
AFSO21	<ul style="list-style-type: none"> <li>- combines multiple techniques for synergy</li> <li>- enables continuous process improvement</li> <li>- eliminate waste/maximize value</li> </ul>
Lean	<ul style="list-style-type: none"> <li>- eliminate waste</li> <li>- improve processes with visual mapping</li> <li>- focus on value added process</li> <li>- create flow</li> <li>- enable perfection of processes</li> </ul>
Six Sigma	<ul style="list-style-type: none"> <li>- eliminate waste, defects</li> <li>- enhance quality</li> <li>- identify root causes of problems</li> <li>- implement process improvement</li> <li>- standardize/measure effectiveness</li> </ul>
Theory Of Constraints	<ul style="list-style-type: none"> <li>- identify and eliminate problem areas</li> <li>- continuous process improvement</li> <li>- visually depict current process, future process, transition plan</li> </ul>
Business Process Reengineering	<ul style="list-style-type: none"> <li>- create value</li> <li>- reduce cost</li> <li>- accelerate the flow of information</li> <li>- prioritize education and training</li> </ul>
Interorganizational Relationships	<ul style="list-style-type: none"> <li>- trust, commitment</li> <li>- quality communication</li> <li>- joint problem solving</li> </ul>

## **Funding Issues**

This section of the literature review is intended to provide a basis for funding recommendations. Like the rest of the Air Force, the STP office is subject to Department of Defense budget constraints. In a 2006 report to the Committee on Armed Services, the GAO, after extensive research of commercial companies, recommended that the Department of Defense set aside dedicated funding to manage technology transition. It is important to reassert one of the main problem areas addressed by this research, mainly, providing recommendations for dedicated funding sources and levels for STP to migrate proven and mature technologies to the depots. As explained by the GAO, the leading commercial companies they studied all ensure that funding for technology projects is protected at the corporate level. They assert that in order to be successful, the department of defense needs to mirror the corporate practices of companies like Boeing, 3M, Motorola, and IBM. According to the GAO report, all of these firms leverage dedicated technology transition money and that this type of strategic planning is critical to ensuring that the right technologies ultimately transition to the right product line in an economical and timely way. (GAO, 2006) In line with this argument, the Depot Maintenance Strategic Plan (2008) specifically states that in order to improve its world class operations, it must continually invest in equipment and infrastructure commensurate with private industry partners as well as investments in business process improvements (2008). This document clearly established a strategy driven by process improvements and dedicated funding to support technology transition goals.

## Synthesis

The purpose of this chapter was to review relevant literature and highlight the significant principles from that literature to provide a basis for analysis. One of the main thrusts of the STP program office is to act as a multi-organizational facilitator of funding and technology insertion road mapping. In that light, the research effort was focused on two main areas of interest. The first focus of the research was to identify possible process improvement recommendations for the STP program office and the second was to identify possible funding sources and associated levels of funding to help ensure the program could facilitate the rapid migration of proven technologies to the sustainment depots. Since the focus of the research was not intended to be specific to any particular technology insertion effort, the process improvement methodologies are intended to provide a basis for system-wide application and involve all the stakeholders in the process to help ensure focused support from the STP program office to the end user.

The second portion of the research is aimed at identifying funding sources and appropriate levels of funding. The research effort focused primarily on relevant literature aimed at justifying the need for leveraging dedicated funds to support technology transitions for sustainment requirements. This justification is not predicated upon specific dollar amounts or specific sources, but lends credibility to the fact that overall program success will be determined by the corporate level departments dedicating funds in support of sustainment objectives.

With the literature reviewed and applicable key concepts addressed, the next step will be to examine the methodology developed to evaluate the technology insertion process. The following chapter describes the methodology in detail.

### **III. Methodology**

#### **Chapter Overview**

This section of the research report describes the methodology used in this study. As an overview, the basic method used to determine viable recommendations for process improvement and dedicated funding solutions was purely qualitative in nature. The specific method was a case study analysis of technology insertion programs with no assumption that they were either examples of successful or unsuccessful programs with regard to the process or funding sources. It was simply assumed, as stated in the introduction, that these particular project case studies are representative of a typical technology insertion efforts that the STP program office would be involved with. The first section describes the process for determining the methodology most suitable for this research. Remaining sections of this chapter discuss the specific research and data collection and methods as well as data analyzing methods.

#### **Determination of Methodology**

The first step in the research was to determine suitable method to answer the research questions. In the case of this research, a problem was identified by the sponsoring organization which narrowed the focus of the research to a specific topic. The next step was to identify the specific type of research to conduct to best address the research problem. As explained by Leedy and Ormrod (2010), research methodology can be defined in two broad categories, quantitative, or qualitative. They further explain that quantitative research involves looking at amounts or quantities of one or more variables, and that qualitative research involves examining characteristics or qualities that cannot be reduced easily to numeric values. Based on the fact

that this research effort was going to examine business processes and funding requirements and could not easily be reduced to numerical quantities for evaluation, a qualitative research method was employed. To further reduce the qualitative method to a specific technique, the researcher had to address several questions on how the research would be conducted. It became apparent that the majority of questions asked were how and why questions, and that a case study would be the best method of qualitative research to use. Additionally, Leedy and Ormrod (2010) state that case studies involve a particular individual or program which is studied in depth for a defined period of time. They go on to state that a case study can examine two or more cases, in the case of this research, technology insertion cases, and make comparisons or generalizations about the data collected. These types of case studies are referred to as multiple, or collective case studies. According to Yin (2003), case studies are the preferred strategy when “how” or “why” questions are being posed. He continues to explain that case studies are a good choice when the researcher has little control over events and when the focus is on a contemporary phenomenon within some real-life context. This situation best described the research intent and that a case study, more specifically a cross-case analysis would be the best method to employ to answer the research questions.

To further support the rationale for using the case study method for this research, Leedy and Ormrod (2010) suggest that there are five steps to data analysis for a case study. The following list summarizes those steps:

1. *Organization of details about the case:* The specific facts about the case are arranged in a logical order
2. *Categorization of data:* Categories are identified that can help cluster the data into meaningful groups.

3. *Interpretation of single instances*: Specific documents, occurrences, and other bits of data are examined for the specific meanings that they might have in relation to the case.
4. *Identification of Patterns*: The data and their interpretations are scrutinized for underlying themes and other patterns that characterize the case more broadly than a single piece of information can reveal.
5. *Synthesis and generalizations*: An overall portrait of the case is constructed. Conclusions are drawn that may have implications beyond the specific case that has been studied (Leedy, 2010).

Based on these five steps, a case study is the best method to conduct the research and provide generalized recommendations for STP process improvement methodology and funding recommendations. It should be restated that STP influences and facilitates interorganizational processes among multiple organizations and stakeholders. Leedy and Ormrod (2010) suggest that qualitative researchers seek explanations and predictions that will generalize to other persons and places with the intent to establish, confirm, or validate relationships and to develop generalizations that contribute to existing theory. This concept is particularly important to this research and directly applicable as the research is not attempting to suggest a new form of process improvement or funding, but merely to recommend generalized insight on using existing theories or practices to answer the research questions, and provide plausible recommendations to address the issues. With the specific type of research method identified, the research now had to identify a prudent process to achieve results. The basic concept was to begin by attempting to understand what the driving force behind the STP process was and how it came to exist. This was accomplished by intense observation and interaction with key stakeholders in the STP process. Throughout the course of this case study research, the researcher was continually involved in stakeholder meetings and gatherings and even participated in some telephonic



conferences between the STP office and depot personnel involved in the technology insertion process. The research effort also included an orientation visit with the sponsor (AFMC/A4DM) to two of the three Air Logistics centers to participate in discussions involving the five case study programs. As Leedy and Ormrod (2010) suggest, qualitative researchers enter the research with an open mind, immerse themselves in the complexity of the situation, and interact with their participants while remaining detached so they can develop unbiased conclusions. This was definitely the case for this research project, and led to an in-depth understanding of the relevant issues.

With the category and specific type of research to be conducted identified, the next step was to determine a data collection method. Not only did the researcher need to identify how to collect the data, but also, what pertinent data to collect. This was an evolving process throughout the research effort, but ultimately the research problem drove the methodology for what data to collect and how to collect it. As Yin (2003) explains, case study data collection does follow a formal plan, but the specific information that may become relevant to a case study is not readily predictable. As evidence is collected, judgments may lead to the immediate need to search for more evidence. This was definitely the case for the multiple case study approach in this research.

### **The Process of Data Gathering**

The data gathering process for this qualitative research effort primarily focused on continuous interaction with the personnel involved with technology insertion efforts at all levels. The researcher, as a participant in an ongoing effort by the STP program office to better understand the complex architecture involved in the technology insertion process, was an

observer. As Leedy and Ormrod (2010) explain, this provides a unique capability, and for the purpose of this research, a very fitting capability. Leedy and Ormrod suggest that qualitative research observations are intentionally unstructured and free flowing. The researcher shifts focus many times as new and potentially significant events present themselves. (2010) This observation approach proved particularly helpful in the research effort for this report. Schram (2006) also offers that by being a qualitative researcher and observer, your task is both derived and constrained by your presence in the study. This makes the research effort inherently interpretive and incomplete. He asserts that the bottom line is that there is no bottom line and that it is not feasible or necessary to reach some ultimate truth in order for the study to be credible and useful. This is a particularly useful outlook for the purpose of this research effort since the process of technology insertion is ever evolving and shifting focus. The purpose therefore; is to provide research based on a methodology that can yield credible recommendations in varying settings of technology insertion environments. The overall approach to the data gathering process was to be an active observer and gather as much data as possible for an in-depth analysis and consolidation to provide useful recommendations for continuous process improvement based on that data.

### **Data Collection Methods**

According to Leedy and Ormrod (2010), some common sources of qualitative data are interviews, observations, and electronic documents. The primary data collection methods used in this research effort was initially a questionnaire and observations of STP program office interactions. The questionnaire was intended to provide a basis for answering the research purely from a funding perspective, but what it actually did was facilitate in-depth discussions

about relevant topics and help scope the project in a new dimension focused on continuous process improvement in addition to addressing questions about dedicated funding requirements. Leedy and Ormrod (2010) term this approach as emerging design, and explain that as data is collected early in the research effort, it sometimes influences the kinds of data that are gathered later in the effort.

Initially, one questionnaire was utilized for the research effort. It was administered via e-mail to all of the project engineers or primary points of contact for the technology insertion programs evaluated. This was done two weeks prior to a scheduled orientation visit. The researcher's intent was to gather the questionnaires during the visit and clarify and expand upon any answers that were provided by the respondents. The questionnaire was composed of a mix of yes or no questions, and some open ended questions to gain insight on how and why the process worked in its current state. In addition to the questionnaire, the researcher attended an orientation visit to the Ogden Air Logistics Center depot and the Oklahoma City Air Logistics center depot. On each of these orientation visits, the researched employed face-to-face interaction with key stakeholders to glean further insight into STP program processes and funding related issues. Throughout the research, electronic mail was used as a primary means of clarifying any questions on process or funding issues, as well as attending telephonic conferences between the STP program office and project engineers at Hill Air Force Base. Additional data was gathered by reviewing relevant regulations and documents pertaining to the STP program office scope of responsibilities and depot operations and strategy.

These data collection methods described above were employed to allow for sufficient data collection as literature pertaining to sustainment technology process for the Air Force is

scarce. Additionally, as the research effort emerged from gaining a basic understanding and then refining the scope to a relevant area, the researcher learned from observation and interaction with key stakeholders that there was much more to the process than a simple questionnaire would reveal. It became apparent that the most useful data for the project would come from the end users or STP program office customers who facilitated technology insertion efforts.

### **Data Analysis Methods**

Once the data collection was complete it would need to be arranged for proper examination and analysis. As Yin (2003) explains, analyzing case study evidence is especially difficult because the strategies and techniques have not been well defined. He offers five specific techniques for analyzing case study evidence; pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis. After collecting the data for the five cases, it was determined that the best method to analyze the data would be to combine two of the techniques offered by Yin. These two approaches are pattern matching and cross case analysis of tabulated data. This method is also supported by Miles and Huberman (1994) as they list six approaches to case study data analysis, two of which include categorizing evidence within a matrix and tabulating the frequency of different events discovered. For this research effort, the process consisted of pulling the raw data from each case study, categorizing the data, and then tabulating it into categories for ease of understanding. Once the data was categorized, a table was developed to determine frequency of occurrence which allowed for a simple method of determining relevant recommendations based on that categorized data.

## **Summary**

This chapter described the research methodology and data collection methods used in this effort. More specifically, it explained the processes used and the justification of each. Because of the qualitative nature and uniqueness of the research objective, an emerging design became the most useful approach to the case study analysis. As the data collection process began, the researcher, by acting as an observer, was constantly gaining additional insight that became useful in the research project. Through interaction with process owners and experts, data collection methods yielded a significant amount of relevant information. The next section of this report examines that data and associated findings.

## **IV. Results and Analysis**

### **Introduction**

The focus of this chapter is to present and analyze the data that was collect by the methods described in the previous chapter. A significant portion of the data was gathered during orientation visits to the Oklahoma City and Ogden Air Logistics centers. These orientation visits and subsequent electronic mail and telephonic follow ups provided the data required to determine recommendations for this report. For simplification and ease of understanding, this chapter will provide demographics, case study summaries, tabulated raw data, and consolidated data tables determined by cross-case comparison and categorization. In concluding, the data will be synthesized and categorized to provide a basis for the recommendations and conclusions in the following chapter.

### **Demographics**

Before revealing the specific data collected during the case studies, demographics of the data are provided as a synopsis of the case study areas examined. The intent of providing demographic data is to lend credibility to the assumption that the technology insertion projects and subsequent conversations with senior technology working group representatives and science and technology stakeholders is indeed representative of the typical technology insertion efforts. By reviewing projects and personnel that span the enterprise, the results are assumed to be applicable to typical technology insertion efforts. The demographic data is provided in Table 3:

**Table 3. Demographic Data**

<b>Case</b>	<b>Location</b>	<b>Depot Process</b>	<b># of Personnel involved in discussion</b>
A	OC-ALC	Manufacturing	3
B	OC-ALC	Inspections	3
D	OO-ALC	Manufacturing	5
C	OO-ALC	Tooling	3
E	OO-ALC/AFRL	Management	4

### **Case A**

Case A was a project examination at Tinker Air Force Base, Oklahoma City, Oklahoma. This project employs a suite of technology and new processes to deliver highly efficient and cost effective thermal spray powders for depot maintenance requirements. During the project examination and interaction with key project managers and personnel, it was determined that the implementation of project A was successful in terms of a technology insertion, but it was also learned that the success was not due to STP processes. Individuals involved in the technology insertion effort were creative in finding funding avenues and based on answers provided by key personnel, funding for this project was personality driven and also driven by environmental concerns. The Propulsion Environmental Working Group had heavy involvement in making this project a success by emphasizing the reduction in the environmental footprint that installing project A would have, specifically a major reduction in chrome usage. Although the insertion of the project may in some way help meet strategic sustainment goals, individuals indicated that sustainment strategy is not what drove the process. Additionally, information specific to the Oklahoma City Air Logistics Center (ALC) was gathered regarding insight on the history of, and

how the technology insertion process works in its current state. This data is relevant because it provides an as-is look at a technology insertion process and helps to identify the way forward. Process owners indicated that there seemed to be no central source of decision making to communicate guidelines for decentralized execution of tasks regarding technology insertion projects. These same process owners also expanded on what they thought the STP program office was responsible for which is: long-term facilitation of the technology insertion process and allocating appropriate funding to support it.

## **Case B**

Case B involved examination of a project at Tinker Air Force Base, Oklahoma City, Oklahoma. The project is focused on improving capabilities in the areas of inspection reliability for safety of flight structures with accurate and cost effective detection of corrosion damage. This program consists of an independent third party review of all nondestructive inspections (NDI) performed on safety of flight structures to ensure that technical orders accurately describe details necessary to effectively accomplish these inspections. Procedures for implementation of organizational methods, tools, and conformal probes were reviewed to improve inspection reliability. As part of the project, prototype tools and probes were developed and tested to verify improvements, followed by drafting finished procedures for maintenance technical orders and operations. The results of the review were disseminated to system program managers who were responsible for implementation. Two key facilitators of the project were questioned regarding specifics of the program and how it related to the STP program office in order to gain an understanding of how the overall technology insertion process and associated funding were executed. Although the project is not complete, it still provided great insight for the research



effort. The process owners indicated that the technology insertion was driven by a safety concern discovered during inspection of a C-130 aircraft undergoing depot level maintenance. As a reaction to the wing spar cracks found in the C-130, the responsible stakeholders began to look for a solution to the problem and identified technology that was currently in use for F-22 inspection processes. This new technology was adapted to meet other airframe requirements that required increased capabilities. The process owners also indicated that they were not familiar with STP or its processes. Although they were not familiar with STP or its responsibilities in the technology insertion process, NDI project managers offered some insightful information. They indicated that from their perspective, a successful technology insertion started at the end user as they were best able to identify what capability they required. They also indicated that conveying the justification for a new project in a short document was difficult to do, and that being able to engage in face-to-face discussions was more helpful for producing funding sources to support projects. They also indicated that the biggest roadblock to overcome was the bureaucracy of the system to secure funds. Additional discussion revealed that they believed having advocates at the higher levels helped ensure projects were supported and funded. With regard to funding, this team expressed frustration about two points of the current system. First, they explained that they were project engineers, not contracting and procurement specialists and that being a champion for a new technology insertion effort required a considerable amount of time and energy. They explained that having dedicated contracting or procurement personnel to work the technology insertion efforts would be a tremendous improvement. Secondly, they explained that it was hard to justify expending a great amount of effort on a proposal and justification when you knew there was no money dedicated to the cause. The last point conveyed by the team was that at higher

levels, projects would only be supported if they had an ability to generate high returns on investment. As they explained, this was frustrating because sometimes projects aimed at productivity increases could not be quantified in terms of a large return on investment.

### **Case C**

Case C involved examination of a project at Hill Air Force Base, Ogden, Utah. This particular project integrates LASER technology to create an automated system for removing coatings on aircraft surfaces via ablation methods in an efficient and cost effective manner. The technology was purchased from a commercial company and installed in the depot to replace an older version of similar technology. As indicated by the project engineer, this was a push technology to reduce cost and floor space occupied by the previous technology. The project engineer indicated that the previous equipment was not organically maintained, was very expensive to operate, and required a lot of space in the shop. The personnel involved with operating the equipment were quick to describe the benefits of the new system. According to the team, this new technology has dramatically increased the amount of parts processed annually and significantly reduced cost to operate by over \$400K annually. When asked if the STP program office was influential in the migration of their proven technology to depot processes, the project engineer indicated that he was not familiar with STP and had no real knowledge of the process. The project engineer also indicated that it was frustrating to spend a lot of time putting together a proposal and justification for a new project when there was no money to support it. He explained that he had better results by engaging known sources or advocates to help leverage funds for new technology insertion projects. Lastly, the project engineer explained that the entire process of inserting new technology was outside the scope of his primary responsibilities and

that he had no formal contracting or procurement training. He expressed an urgent need for this expertise to facilitate technology insertion which would allow project engineers to focus on their core competency of managing depot shop processes and resources.

#### **Case D**

Case D was a project examined at Hill Air Force Base, Ogden, Utah. This project involved new technology for a tooling system that is intended to significantly reduce cost and provide enhanced capabilities to meet tooling needs in an efficient and cost effective manner. The process owners indicated that this project began as Small Business Innovation Research (SBIR) program with Air Force Research Laboratory involvement. They also indicated that it was a technology that was pushed into use because of congressional money specific allocated for the implementation of this new technology. The project manager also indicated that regarding technology insertion, his focus was on solving problems. Although he did indicate that strategy was always in the back of his mind, he did not allude to what specific strategy. This particular project manager was familiar with the STP program office and indicated that the STP program office provided the big picture for what was going on, especially in the Technology Working Group (TWG) process. When asked about dedicated funding for technology insertion efforts, the process owners indicated that due to the unique mission of the office and other funding that was available to them, having dedicated money for technology insertion through formal STP channels would actually not be beneficial. He explained that if there was dedicated money for them to attempt to leverage, he would not have the proper manning or expertise to target the money because such efforts would require contracting and financial experience if they were to be done properly. The last main point offered was a general statement about technology insertion

efforts. According to the project manager, it was crucial that all stakeholders be educated on the process of technology insertion and that you needed buy in from the top level down. He explained more specifically that the education needed to include informing all the stakeholders why the S3C, SRG, STP, and TWG exist and what functions they perform and how they can benefit you.

### **Case E**

After completing the case study analysis of the four previously mentioned projects, the research sponsor set up a telephonic conference and face-to-face meetings with a senior TWG representative and a long time science and technology representative from the Air Force Research Laboratory (AFRL). The intent of case E was to help synthesize the data gathered from the lower echelon stakeholders and gain a larger perspective on the system-wide process as it currently existed. The senior TWG representative and AFRL science and technology representative were not informed about any previous data that was collected so there would be no bias induced from previous respondents. The senior TWG representative initiated the discussion with a recap of current technology insertion initiatives at the base he was most involved with. He explained that a lot of the projects were being driven by environmental concerns and reducing environmental footprint or emissions as opposed to achieving some return on investment threshold, and followed up with a rhetorical question aimed at determining if the S3C or SRG even considered this in their sustainment strategy. He continued by explaining that dedicated funding for technology insertion would need to be controlled carefully and strategically to ensure that Air Force-wide sustainment goals were being considered and not just being focused locally to one area. His follow up to this funding requirement was to explain that

dedicated funding can actually make the process work as it is designed to work. In its current state, the STP process allows the TWGs to funnel technology needs to higher levels for approval. Without a dedicated funding source, once the TWGs consolidate technology insertion requirements, there is no money to support them so technology insertion advocates immediately try to work around the system to find alternate sources of funding to bring projects to fruition. He also reiterated that it was hard to motivate people to produce a quality proposal and justification because they knew that even if it was accepted, there would be no money to fund it. He then commented on process issues and explained that lower echelons involved in technology insertion need to be aware of what the upper management focus is and that it would be even more helpful if this focus was expressed in terms of aircraft availability rates. It was his impression that the current process consists of the technology needs being identified locally by the bases as opposed to being identified by a high level strategy for sustainment needs. He went on to explain that in his opinion the current process for inserting new technology was broken and there was a definite lack of communication. He cited an example from last year's call for technology insertions. As he explains, each of the four standing TWGs was responsible for submitting 5 requests for new technology in the beginning of fiscal year 2010 for a total of 20 proposals. These proposals were submitted to the S3C in December of 2009. As he highlighted, this was already 4 months into the new fiscal year when money had already been allocated. The S3C gave final approval for the 20 projects, but there was no money to fund them. Lastly, the senior TWG representative explained the need for contracting and financial management support to assist in technology insertion efforts. As he explains, the project engineers are currently responsible for all matters of technology insertion and they often run into roadblocks when they

attempt to get civil engineering approval for technology insertion requirements. He stated that the civil engineering department has their own priorities which are not aligned with technology insertion efforts and by the time their assessment is a priority, the delay is so significant that money cannot be allocated for that fiscal year and the project gets pushed off or the budget which previously allowed for it to happen gets reduced. A subsequent discussion with a science and technology representative from AFRL revealed more insight. As this individual explained, the process is not working correctly; he asserted that the metrics for technology insertion are currently cost driven with no regard to aircraft availability rates. He offered personal insight to suggest that funding was not the issue, but organizational ownership and responsibilities need to be clarified. He went on to explain that based on his years of experience and interaction with many key stakeholders, the process is not working. He advocates that funding be controlled at a much higher level than it currently is, and that the STP program office should be ensuring that technology insertion efforts are in line with strategic sustainment intent set by the S3C and higher levels.

### **Case Study Data Summary**

After gathering data for the individual case studies, the data from each case was reviewed to determine if there were any repetitive themes or items which could be categorized to establish commonality in the cases analyzed. This approach is referred to by Yin (2003) as a cross case analysis, which is summarized in table format. Table 4 summarizes the categorization of the data from each of the five case studies.

**Table 4. Categorized Case Study Results**

<b>Case ID</b>	<b>Response</b>	<b>Keywords/Themes</b>	<b>Category</b>
A	...creative in finding funding avenues	creative funding	Funding
A	...funding driven by environmental concerns	..funding, driven by	Funding, Strategy
A	sustainment strategy is not what drove process	strategy, process	Strategy, Process Improvement
A	no central source of decision making to communicate guidelines	communication, guidelines	Communication, Strategy
B	technology insertion was driven by a safety issue	driven by	Strategy
B	project office started to look for a solution to the problem	solution to problem	Strategy
B	not familiar with STP or its processes	not familiar	Education & Training, Communication
B	successful technology insertion started at the end user	started at end user	Strategy, Education & Training
B	conveying the justification for a new project was difficult to do	difficult to do	Education & Training, Communication
B	biggest roadblock... bureaucracy of the system	..bureaucracy	Process Improvement
B	finding money to fund new projects	Fund	Funding
B	no contracting/procurement training...having dedicated personnel to work technology	Training	Education & Training
B	no money dedicated to the cause	Money	Funding
C	push technology	Push	Strategy

(continued)

(Table 4 continued)

C	not familiar with STP...had no real knowledge of the process	not familiar, process	Education & Training, Process Improvement, Communication
C	no formal ....training	Training	Education & Training
D	technology was pushed into use	Pushed	Strategy
D	focus was on solving problems	focus, problems	Strategy
D	Would not have proper manning or expertise	..expertise	Education & Training
D	crucial that stakeholders be educated on the process	...educated	Education & Training
D	buy in from top level down	top down	Strategy
E	projects being driven by environmental concerns	..driven	Strategy
E	dedicated funding would need to be controlled strategically	funding, strategy	Funding, Strategy
E	no dedicated funding source	..funding	Funding
E	work around the system	..work around system	Process Improvement
E	lower echelons...need to be aware of what upper management focus is	need to be aware, upper management focus	Education & Training, Communication,
E	technology needs being identified locally as opposed to...strategy	..strategy	Strategy
E	current process...broken	process, broken	Process Improvement
E	definite lack of communication	Communication	Communication

(continued)

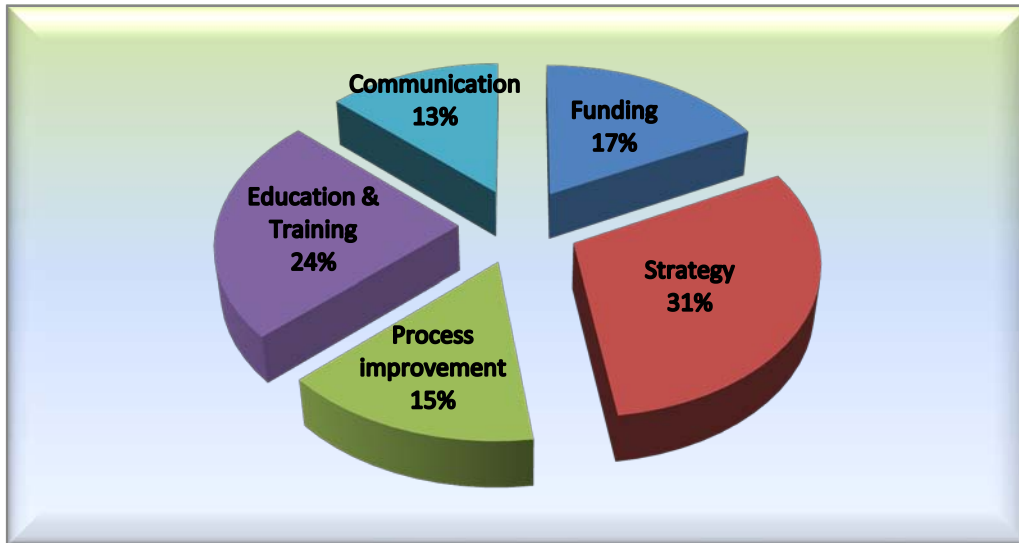


(Table 4 continued)

E	no money to fund them	..fund	Funding
E	contracting and financial management support to assist	support, assist	Education & Training
E	delay in process is so significant that money cannot be allocated	delay, process, significant	Process Improvement
E	process not working correctly	..process	Process Improvement
E	organizational ownership and responsibilities need to be clarified	..clarified	Education & Training, Communication
E	ensuring...in line with strategic sustainment intent	..strategic	Strategy

With the data arranged in this format, categorized improvement areas were inserted into an excel spreadsheet to reveal the percentage of the 46 total observations that were relevant to each category.

Figure 4 depicts the five improvement areas identified by the data from cross-case comparisons. Out of 46 total data points, strategy comprised 31 % of the data, education and training 24%, funding 17%, process improvement 15%, and communication 13%. With the individual areas identified, the next step was to separate the data to break out the specific improvement area and determine which case it was derived from to see if any significant data patterns emerged. Additionally, it would allow for determining if specific focus areas were related to specific cases. The resulting table is shown in table 5:



**Figure 4. Category Summary Results**

**Table 5. Case Study Summary**

Improvement Area	Case Summary		Total # of times recorded*
	Specific Case	% of Cases	
Strategy	A,B,C,D,E	100%	15
Communication	A,B,C,E	80%	7
Education & Training	B,C,D,E	80%	7
Process Improvement	A,B,C,E	80%	11
Funding	A,B,E	60%	7

\*Improvement areas could be mentioned multiple times per case

With the data categorized and the five main improvement areas identified the next step was to synthesize the data categories into a format that provides a clear path for providing conclusions and recommendations. Conclusions and recommendations will be based on providing insight on methodology for process improvement in line with the literature review and in the areas of process improvement relevant to the focus areas determined by case study analysis. Although the highest percentage of respondent categorized data involves strategy, it is not the aim of this research to provide strategic direction for STP process. The data gathered relevant to strategy is intended to provide a basis for process improvement recommendations related to the importance of clearly defining and communicating strategic intent.

The analysis of the data reveals that there were indeed some common themes among the projects and respondents. These common themes provide a basis for methodology based recommendations for STP in all of the process improvement focus areas the data revealed. The next chapter will expand upon specific recommendations and conclusions.

## **Summary**

The intent of this chapter was to report and analyze the data gathered during the five case studies. The data analysis revealed five areas that process improvement methodologies such as AFISO21, Lean, Six Sigma, TOC, BPR, and interorganizational relationship analysis methods can be applied to help improve STP processes. As evidenced by the literature reviewed, applying the concepts mentioned above is directly in line with the process improvement requirements indicated by the data. The data supports the view expressed in the research

problem that improvements are required across the scope of STP processes. The following chapter will provide the conclusions and recommendations based on the data from this chapter.

## **V. Conclusions and Recommendations**

### **Conclusions**

The primary purpose of this research was to determine recommendations for process improvement methodology regarding STP processes and also provide funding recommendations for technology insertion efforts controlled by the STP program office. The research was aimed at analyzing the current state of the process through a cross-case analysis of several technology insertion projects at various locations. The purpose of the case study analysis was to identify areas that required improvements and then based on those results, provide a framework of methodology that could be applied to make the necessary improvements. The focus areas outlined in the literature review served as a lens through which the researcher analyzed each case study of technology insertion projects. After careful observation, interaction, and analysis of results, it is concluded that there is no formally defined process that is understood by all stakeholders in the STP process. Additionally, the data suggests that issues exist in the areas of strategy, communication, education and training, processes, and dedicated funding to support technology insertion efforts. Based on the conclusions, which are supported by the data, the effort to insert sustainment related technology into the depots can benefit from applying several of the process improvement techniques discussed in the literature review. The following sections will address applicable recommendations for each of the five recommended improvement areas.

### **Strategy**

As previously addressed, it is not the intent of this research to provide specific strategy recommendations for the STP process. It is however important to note that the most significant improvement area revealed by the case studies, and included in 100% of the cases analyzed was

related to strategy. Based on the research and supported by data, it is recommended that the sustainment community review and possibly redefine the strategy relevant to technology insertion for the depots. Many of the proposed process improvement techniques could improve operational effectiveness, but as Porter (1996) explains, the pursuit of operational effectiveness is alluring because it is concrete and actionable. These improvements usually produce reassuring progress and become cyclical due to the immediate results and attention they receive. He urges that managers not get so caught up in the race for operational effectiveness that they forget about strategy. Porter (1996) also offers that the operational agenda is the proper place for change and improvement to achieve best practices, but that the strategic agenda demands continuity and must not be compromised. The data supports a recommendation not only to ensure that proper strategy exists, but that it is fully communicated to all stakeholders involved in the STP process.

## **Communication**

Problems in the realm of communications were cited in 80% of the cases analyzed and mentioned a total of seven times. Poor communication, if viewed as a form of waste, can be approached by multiple process improvement techniques as indicated in table 2 in the literature review chapter. To provide a more specific methodology for improving communications based on the literature, business process reengineering and facilitating strong inter-organizational relationships are the most applicable. Business process reengineering enhances value by accelerating the flow of information and facilitating strong inter organizational relationships promotes focusing on quality communications. The data supports the recommendation for improving communication over the gamut of STP processes. Although the research was not dedicated to determining what specific communication required improvement, future research

could be focused in this area to provide more insight. By applying the techniques of business process reengineering and focusing on developing strong inter-organizational relationships the STP process should be able to reduce the effects that the current lack of communication has on the system whether these effects are perceived or real. Effective communication is a key element of success for organizations. As Darling and Bebee (2007) point out, communication is the primary way in which any group can become aligned behind the over-arching goals of an organization. They suggest that leaders facilitate communication that is understood accurately by others and achieves its intended effects.

### **Education & Training**

Cross case analysis of the data revealed that improvements in education and training were mentioned in 80% of the cases and a total of 7 times. According to the literature review, the most effective method for prioritizing education and training is business process reengineering. By applying the methods of business process reengineering and potentially redefining the STP process in whole or in part, research suggest that the new process should give priority to proper education and training of the workforce. The specific recommendation for education and training supported by the case study data is to ensure that stakeholders at all levels fully understand their role in the technology insertion process and how to effectively accomplish their portion of the mission. Additionally, as indicated by the data, it is recommended that personnel with education and experience in contracting and procurement be utilized to fully support technology insertion efforts. The final recommendation for education and training improvement is to develop a flow where the STP process can be explained from top to bottom for all organizations involved so that all parties in the process are fully aware of the STP office

capabilities and responsibilities. This “Responsibilities and Capabilities Symposium” could take place in the form of an “STP Road Show” to each of the Air Logistics Centers and should involve as many key personnel as possible. Additionally, there needs to be an open dialogue for constant interaction between the STP program office and other members of the STP process to ensure stakeholders are educated and trained on the most up to date information.

## **Process Improvement**

Effective and efficient mission accomplishment is the overarching goal, and continuous process improvement provides the long-term means to get there. The need for process improvement was specifically mentioned in 80% of the cases analyzed a total of 11 times. Based on the data collected, the recommendations for process improvement include a full initiation of an AFSO21 event regarding the insertion of new technology into depots. As explained in the literature review, this will allow the STP office to utilize multiple process improvement techniques to synergistically improve technology insertion efforts. Most of the data regarding process improvement was centered on explaining that the current process was broken or not working properly. It is the very aim of AFSO21 to determine what the problems are and then determine the way forward to create a process focused on value added practices and elimination of all waste. Specifically it is recommended that the STP office and key stakeholders at all levels be trained on AFSO21 practices and procedures and then communicate these to the remaining personnel. By applying the eight step AFSO21 process, the technology insertion process is sure to realize increases in current performance. As part of the AFSO21 initiative, an additional tool to help analyze the current process and determine a way forward is the use of Logic Tree diagrams. It is recommended that the STP office create a current reality tree, future reality tree,



prerequisite tree, and transition tree to clearly depict the plan for process improvement. The logic trees should focus on the areas identified as potential improvement areas by this research. Of particular importance, the prerequisite tree should include a breakdown of all components necessary to fully implement new technology with clearly defined metrics for gauging each components performance. As a note, logic tree software is commercially available and could be a powerful enhancement tool for STP process improvement.

## **Funding**

Contrary to popular belief that funding is the only problem, data captured during case study analysis revealed that funding issues were discussed in the lowest percentage of cases (60%) for a total of 7 occurrences. The majority of these funding issues mentioned by the respondents centered on the fact that funding dedicated to technology insertion was not available from a centralized source. This forced the facilitators of the new technology to be creative in finding sources of funding. Based on the data, a recommended solution for funding issues is to explore potential avenues of support that already exist. Although no specific research was dedicated to examining all of the sources of money used to fund technology insertion projects, interaction with the STP program office and key players involved in the process yielded sufficient evidence to state that there was no central source and that money seemed to flow from many different sources and avenues to bring projects to implementation. One particular area of interest regarding dedicating money to technology insertion was expressed multiple times in the case studies. Project managers for technology insertion were often discouraged from expending extra time and effort on a proposal that did not have money dedicated to support it even if it was accepted. Based on that information, a recommendation for improved success would be to

provide an incentive measure for potential proposals in the form of dedicated funding provided that the proposal meets the sustainment requirements determined by the S3C. Additionally, it is recommended that high level sustainment officials seek out potential existing funding sources that could be used to fund technology insertions. As identified by senior science and technology representatives and related documents, sources could include Capital Purchase Plan (CPP) funds, Small Business Innovative Research (SBIR) funds, and possibly the ability to leverage funding support under the new Centralized Asset Management (CAM) initiative. Process improvement initiatives outlined in this report can help ensure that money leveraged for technology insertion efforts provides maximum support for sustainment objectives in a cost effective and timely manner. An all out effort to tackle every improvement area simultaneously could be a daunting task. Therefore, a phase-based approach to process improvement is recommended which may ultimately result in dedicated funding. In an effort to convey the recommendations in a phased based approach for system wide process improvement reference Figure 5:



**Figure 5. Process improvement phased based approach**

Figure 5 could serve as a road map for continuous process improvement across the spectrum of technology insertion processes and organizations. As identified in the recommendations above, step one would be to ensure an accurate strategy for the STP process is in place. Once the strategy is clearly identified it needs to be communicated throughout all organizations involved in the process. With a clear strategy communicated throughout, the stakeholders need to establish a training and education process to ensure all personnel are aware of how the strategy will be achieved. Once this happens, continuous process improvement initiatives outlined above will provide an effective and standardized process that maximizes effectiveness and eliminates waste. Once the process is standardized and key performance indicators are outlined and tracked, leveraging dedicated funding to support technology insertion efforts should be attainable.

### **Summary of Recommendations**

The following list provides a review of recommendations for improvements in the technology insertion process specific to AFMC:

- Reaffirm AFMC's sustainment technology insertion program objectives
- Clearly communicate program objectives to all STP stakeholders
- Challenge STP stakeholders to develop focused processes targeted to meet those objectives
- Facilitate strong inter-organizational relationships among stakeholders
- Apply Business Process Reengineering principles to facilitate quality communication and enhance education and training
- Establish STP road show and/or recurring Technology Insertion Symposium
- Initiate full AFSO21 event on current technology insertion process

- Migrate AFMC AFSO21 training methods to STP stakeholders
- Identify/Simplify/Consolidate metrics for measuring success of STP processes related to technology insertion efforts
- Ensure senior leadership identifies funding sources to establish a centralized venue to support technology insertion efforts
- Ensure cyclical approach to recommendations to promote continuous process improvement

### **Recommendations for Future Research**

This case study research relied exclusively on qualitative data. It is recommended future research incorporate quantitative data as well as statistical analysis where appropriate to help capture process improvement initiatives. Of particular emphasis, future research should be focused on a specific improvement area and attempt to statistically measure increases in performance through analysis of metrics established to measure those improvements. In addition, future research could be focused on case study analysis to determine what metrics would be most helpful in each of the focus areas to measure performance increases. This could provide validation for leveraging funding to support technology insertion programs in line with sustainment strategy. Another possible approach would be to dedicate research to an in-depth case study analysis of each of the five recommended improvement areas. This would allow identification of specific reasons why the areas for improvement exist, and should yield recommendations for specific strategies to improve each area.

### **Summary**

Technology insertions are indeed making it to the depot, but not necessarily as a result of a strong repeatable process. The objective of this research is to draw attention to specific areas

identified by case study analysis that could benefit from applying process improvement techniques, and then to provide recommendations based on those findings. This chapter summarized the conclusions revealed by case study data and then based on those conclusions, provided recommendations for improvement based on the methods outlined in the literature review.

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## **Vita**

Major John T. Forino graduated from Edward S. Marcus High School in Flower Mound, Texas. He entered undergraduate studies at Embry-Riddle Aeronautical University in Prescott, Arizona where he graduated with a Bachelor of Science degree in Electrical Engineering in 1996. He was commissioned through the Air Force Reserve Officer Training Corps. Upon commissioning, Major Forino attended undergraduate pilot training at Laughlin Air Force Base, Del Rio, Texas. He subsequently completed initial F-16 flight training and was assigned to the 523<sup>rd</sup> Fighter Squadron at Cannon AFB, New Mexico. After two combat deployments, Major Forino was reassigned to Vance AFB in Enid, Oklahoma where he was a Flight Commander and T-38 Instructor Pilot. Major Forino then returned to the F-16 and was assigned to the 80<sup>th</sup> Fighter Squadron at Kunsan Air Base, Republic of Korea where he served as a squadron Assistant Director of Operations, Wing Director of Staff, and earned his Instructor Pilot qualification. He returned to the United States and was assigned to the 388<sup>th</sup> Fighter Wing, Hill AFB, Utah. As the Chief of Standardization and Evaluation, Major Forino was the lead Functional Check Flight pilot and chief evaluator pilot for the Fighter wing. Upon graduation, Major Forino will be assigned to the Combat Operations Division of the 613<sup>th</sup> Air and Space Operations Center, Hickam AFB, Hawaii.



## **Appendix A**

### **Blue Dart**

The process for inserting new technology into Air Force sustainment depots is broken. Some years ago, Air Force Inspection Agency and Government Accounting Office officials closely examined the process of technology transition and insertion as it effected depot operations. The results are not good news for sustainment professionals, particularly those tasked with ensuring the depots remain a world class organization. One of those organizations is the Sustainment Technology Process (STP) office.

The process of technology insertion involves a plethora of organizations and stakeholders form end user to senior level sustainment leadership. The problems plaguing the current process range from a lack of funding to a network of poorly integrated and confusing interactions among key stakeholders. The Depot Maintenance Strategic Plan (2008) states that STP is tasked with providing a strategic and systematic method to transition technology to improve depot processes, however, many key stakeholders in the process were not even familiar with the STP office or what their responsibilities entailed. The strategic plan goes on to state that STP creates a strategic partnership between the science and technology providers, and the acquisition and sustainment communities to address technology opportunities, solution planning, and programming. Case study data reveals that formal, long-term partnerships are not being sustained. Additionally, a majority of stakeholders stated that the current process is “broken”, or “not working”. Analysis identified five categories for improvement. The first improvement needs to be made in establishing a strategic objective. More specifically, 100% of the cases included statements addressing either the lack of overarching sustainment strategy, or at best that

if there was a strategy, it certainly was not the driving force behind the technology that was being inserted into the depots to “improve the industrial base”. The process also needs to ensure that all the stakeholders know what the strategy is and what the plan is for achieving it. Secondly, a majority of the respondents interviewed for this research recommended increased communication throughout the STP process. With regards to STP technology insertion funding, data reveals that no single source controls money leveraged to support technology insertion. Instead, technology insertion advocates have been forced to seek out their own funding support from multiple sources or any means available to them. The research clearly shows areas for improvement in the sustainment technology process. In order for the Air Force to ensure depots are world-class contributors to national defense, it needs to address these issues with proven tools and techniques aimed at continuous process improvement. The research conducted provides a methodology applicable to each of the improvement areas identified by case study analysis.

## Quad Chart



### SUSTAINMENT TECHNOLOGY PROCESS



#### Description

- Assess current process for inserting technology into sustainment depots
- Provide recommendations for technology insertion process improvement
- Provide funding recommendations in support of STP long term objectives

#### Methods

- Qualitative study of technology insertion projects; cross-case analysis

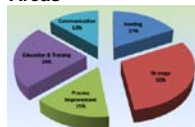
#### Demographics

Case	Location	Dept Process	# of Personnel involved in discussion
A	OC-ALC	Manufacturing	5
B	OC-ALC	Inspection	5
D	OO-ALC	Manufacturing	5
C	OO-ALC	Tooling	3
E	OO-ALC/AFRL	Management	4

#### Results

Improvement Area	Case Summary	Total # of Cases recorded*
	Specific Case	% of Cases
Strategy	A,B,C,D,E	100%
Communication	A,B,C,D,E	80%
Education & Training	B,C,D,E	80%
Process Improvement	A,B,C,D,E	80%
Funding	A,B,E	80%

#### Key Improvement Areas



#### Key Operational Partners

- AFMC/A4D
- Air Logistics Centers
- AFRL
- Lead Researcher: Major John "Voodoo" Forino
- Advisor: Dr. Tim Pettit

#### Potential Benefits

- Technology insertion process driven by strategic vision
- Well defined and executable process for all stakeholders clearly communicated
- Facilitate standardized/repeatable technology insertion process to meet sustainment objectives and war fighter needs



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